CURRICULUM VITAE

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Birth date: December 21, 1943; Washington, D.C.

Education

B.A. Economics 1966, University of Maryland
M.S. Economics 1967, University of Michigan
Ph.D. Economics 1972, Michigan State University

Professional Positions

Professor, University of California at Davis, Department of Agricultural and Resource Economics, July 1985 to present, teaching graduate and undergraduate courses in econometrics and finance.

Visiting Associate Professor of Econometrics and Statistics, University of Chicago, Graduate School of Business, September 1985 to June 1986, teaching a Ph.D. level course in forecasting.

Associate Professor, University of California, Davis, Agricultural Economics Department, July 1979 to June 1985, teaching graduate and undergraduate courses in econometrics and statistics.

Visiting Professor, San Jose State University, September 1978 to June 1979, on one year leave of absence from New York University, teaching graduate and undergraduate courses in econometrics, forecasting, and macroeconomics.

Assistant Professor, New York University, Graduate School of Business Administration, September 1976 to June 1979, teaching graduate courses in econometrics and forecasting.

Economist, Board of Governors of the Federal Reserve System (Washington, D.C.), November 1971 to September 1976. Primary activities included development of optimal control algorithms for the MIT-Penn-SSRC quarterly econometric model (resulting in techniques now routinely used at the Board); econometric software and database access design; quarterly model development and general Federal Reserve staff econometric support; and policy analysis in macroeconomic and econometric areas.

Professional Activities

Associate Editor:
Journal of Economic Dynamics and Control, September 1987 to September 1996.

Program Chair:
Society for Economic Dynamics and Control, 1988 annual meeting.

Invited Sessions;

Invited sessions have been organized for various organizations, including the International Electrical and Electronic Engineers, and the American Statistical Association (1985 and 1995).

Refereeing:

Assorted journals including the *American Economic Review, Journal of Economic Dynamics and Control, Federal Reserve Bulletin, Journal of the American Statistical Association, Journal of Econometrics, American Journal of Agricultural Economics, Optimal Control Applications and Methods, International Economic Review,* and grant applications for HEW and NSF.

Selected Seminars:

Formal seminars have been given at a number of institutions, including the University of California, Santa Barbara, Economics (twice); University of California Berkeley Agricultural Economics; Federal Reserve Board (twice from outside); Purdue University Agricultural Economics; University of Chicago Graduate School of Business Econometrics and Statistics Colloquium (twice); University of Rhode Island Campus Invited Scholar; Stanford Economics Seminar; M.I.T./ Harvard Econometrics Seminar; University of Arizona Agricultural Economics; University of California Davis Statistics; University of California San Diego Economics; and others.

Invited address:

"Multiperiod Optimal Control of the SSRC-MIT-Penn Quarterly Econometric Model," presented to the Federal Reserve Committee on Financial Analysis, Washington, D.C., 1976.

Panel member:

American Bar Association Litigation Section, Products Liability Panel Discussion, March 1, 1991, Palm Springs, CA.

Manhattan Institute Forum on Products Liability, San Francisco, July 10, 1990; attendance of California judicial leaders by invitation only.

Selected grants:

Multiple Giannini Foundation grants, approximately $10,000 each; USDA marketing fellowships, $90,000 (written for the department while chairing the Graduate Advisory Committee); USDA NRI marketing order study grant, $95,000; USDA NRI state space ARCH model development and application to live cattle price volatility, $40,711; others.

Publications and Papers

"Optimal Control of a Linear Macroeconomic Model with Random Coefficients," *Proceedings of the IEEE Conference on Decision and Control,* December 1973, with R. Craine.

"Optimal Control of Large Nonlinear Stochastic Econometric Models," *Summer Computer Simulation Conference Proceedings,* July 1975, with R. Craine and P. Tinsley.

"MINNIE: A Small Version of the MIT-Penn-SSRC Econometric Model," *Federal Reserve Bulletin,* November 1975, with D. Battenberg and J. Enzler.

"Optimal Macroeconomic Control Policies," *Annals of Economics and Social Measurement,* Vol. 5, No. 2, Spring 1976, with R. Craine and P. Tinsley.

"A Structural View of Intermediate Variables," Report to the Federal Reserve Committee on the Directive (reviewing the usefulness of intermediate variables as guidelines for the New York trading desk), June 1976.

"Derived Reduced Form Coefficient Covariances," (Computer Algorithm), *Econometrica,* Vol. 44, No. 4, July 1976.

"Coefficient Uncertainty and Policy Aggressiveness: An Empirical Assessment," *Proceedings of the IEEE Conference on Decision and Control,* December 1976, with R. Craine.

"A Stochastic Optimal Control Technique for Models with Estimated Coefficients," *Econometrica,* Vol. 45, No. 6, May 1977, with R. Craine.

"The Optimal Monetary Instrument: An Empirical Assessment," *Journal of Cybernetics,* Vol. 7, Nos. 1-2, January-June 1977, with R. Craine.

"Estimation from a Pooled Time-Series of Cross-Sections of Simultaneous Equations," *Summer Computer Simulation Conference Proceedings,* July 1977, with W. Donnelly.

"Estimating a Comprehensive County-Level Forecasting Model of the United States," invited paper, *Proceedings of the First Annual Economics of Energy Workshop,* Association of University, Business, and Economic Research, August 1977, with W. Donnelly, E. Hong, F. Hopkins, and T. Morlan.

"Model Estimation with FEDEASY," *Proceedings of the American Statistical Association* (Statistical Computing), August 1977, with R. Herman and J. Condie.

"Fixed Rules versus Activism in the Conduct of Monetary Policy," *American Economic Review,* Vol. 68, No. 5, December 1978, with R. Craine and J. Berry.

"Aggregating Disparate Individuals into Meaningful Macroeconomic Relations: The Case of Consumption," *Proceedings of the Twelfth Asilomar IEEE Conference on Circuits, Systems and Computers,* November 1978.

Modeleasy Level II: A Speakeasy Enhancement for Estimation and Simulation with Simultaneous Equations (User's Guide), Board of Governors of the Federal Reserve System, with several others, October 1978.

"Optimal Macroeconomic Control Policies," (see above) was selected for re-publication as <<Politicas Macroeconomicas de Control Optimo>> in *Hacienda Publica Espanola Instituto de Estudios Fiscales,* No. 51, 1978, Madrid.

"Aggregate Lifetime Income Data Incorporating Demographic Effects," June 1980.

"A Random Coefficient Approach to Seasonal Adjustment of Economic Time Series," *Journal of Econometrics,* February 1981 (lead article), with P.A.V.B. Swamy.

"On Control with Instruments of Differing Frequency," *Journal of Economic Dynamics and Control,* Vol. 3, No. 2, May 1981, with R. Craine.

"The Choice of Monetary Instrument: The Case of Supply Side Shocks," *Journal of Economic Dynamics and Control,* Vol. 3, No. 2, August 1981, with R. Craine.

"Soybean Market Forecast Errors," *Applied Commodity Price Analysis and Forecasting* (Chicago: Farm Foundation, 1981), pp. 466-481, with M. Cerchi.

"Computationally Expedient Openloop Stochastic Control," *Proceedings of the IEEE Conference on Decision and Control,* San Diego, December 1981, pp. 841-843.

"Estimation Analogies in Control," *Journal of the American Statistical Association,* Vol. 76, No. 376, December 1981, pp. 850-859, with R. Craine.

"A Brief Description of the FRB Modeleasy/Fedeasy Econometric Language," *Journal of Economic Dynamics and Control,* Vol. 5, No. 1, pp. 75-79, February 1983, with J. Condie, R. Herman, A. Norman, and R. Porter.

"Classical Versus Bayesian Models: On the Dangers of a Little Bit of Knowledge," *International Journal of Systems Science,* Vol. 14, No. 8, August 1983, pp. 871-875, with R. Craine.

"Nonlinear Estimation with SPEAKEASY," *Proceedings of the Eleventh Annual Speakeasy Conference,* August 1983, pp. 37-46.

"An Econometrician's Guide to Estimating Financial Market Models," November 1983, with M. Cerchi.

"In Tema Di Controllo Ottimale Quadratico Ad Anello Aperto," in *Rivista Internazionale di Science Sociali,* 1, Anno XCII gennaio-marzo 1984, pp. 74-87. ("On Quadratic Open Loop Optimal Control," *International Review of the Social Sciences,* January-March 1984.)

"Quadratic Openloop Optimal Control of Economic Systems," *International Electrical and Electronic Engineers Transactions on Automatic Control,* Vol. AC-29, No. 5, May 1984, pp. 392-39.

"Toward the Resurrection of Optimal Macroeconomic Policy," *Applied Decision Analysis and Economic Behavior,* pp. 23-32 in Vol. 3 of Advanced Studies in Theoretical and Applied Econometrics, Kluwer and Nijhoff publishers, Boston and the Hague, 1984, with L. Karp.

"Classical Econometrics and Stochastic Optimal Control," April 1983, revised June 1984.

Reply to Comments on "The Choice of Monetary Instrument," *Journal of Economic Dynamics and Control,* Vol. 7, No. 3, September 1984, with R. Craine.

"Approximations in Time Series Modelling from a System Theoretic Approach," *Proceedings of the American Statistical Association, Business and Economic Statistics Section,* August 1985, with M. Aoki.

"Markovian Models for Vector-Valued Time Series: A Unified Account for Approximate Model Construction," August 1985, with M. Aoki. (Presented at the Fifth World Congress of the Econometric Society, Boston, Massachusetts.)

"Approximate State Space Models of Some Vector-Valued Macroeconomic Time Series for Cross-Country Comparisons," *Journal of Economic Dynamics and Control,* Vol. 10, No. 1/2, June 1986, with M. Aoki. (Also presented at the Seventh Annual Conference of the Society of Economic Dynamics and Control.)

"Formulating and Estimating Dynamic Stochastic Production Models," June 1986, with J. Antle.

"Forecast Comparisons of Four Models of U.S. Interest Rates," *Journal of Forecasting,* Vol. 7, No. 1, January-March 1988, with R. Craine.

"Foreign Exchange Rate Revisions: A Multiple Currency and Multiple Maturity Analysis," *Journal of Econometrics,* Vol. 37, No. 2, February 1988, with B. Modjtahedi.

"An Instrumental Variable Interpretation of Linear Systems Theory Estimation," *Journal of Economic Dynamics and Control,* Vol. 12, No. 1, March 1988, pp. 49-54, with M. Aoki.

"Econometrics and Linear Systems Theory in Multivariate Time Series Analysis," (University of California, Agricultural Economics Department Working Paper 88-6), April 1988, with M. Aoki.

"Cointegration and Stock Prices: The Random Walk on Wall Street Revisited," *Journal of Economic Dynamics and Control,* Vol. 12, No. 2/3, June/September 1988, pp. 333-346, with M. Cerchi.

"State Space Modeling of Stationary Time Series: Theory and Applications," invited paper, *American Statistical Association, 1988 Proceedings of the Business and Economic Statistics Section,* pp. 51-58, with M. Aoki.

"A Discrete Dependent Variable Approach to Predicting the Success of Agricultural Futures Markets," February 1989 (University of California, Agricultural Economics Department, Working Paper 89-4), with S. Chambers.

"Forecasting Halibut Biomass Using System Theoretic Time Series Methods," *American Journal of Agricultural Economics,* Vol. 71, No. 2, May 1989, pp. 422-31, with K. Criddle.

"Optimal Cross-Year Agricultural Inventories Using State Space Models," May 1989 (Agricultural Economics Department Working Paper 89-11), with J. Dorfman.

"System Theoretic Time Series: An Application to Inventories and Prices of California Range Cattle," March 1988, *Computers and Mathematics with Applications,* Vol. 17, No. 8/9, 1989, System-Theoretic Methods in Economic Modelling I, with K. Criddle.

"A Method for Approximate Representation of Vector-Valued Time Series and Its Relation to Two Alternatives," *Journal of Econometrics,* Vol. 42, October 1989, pp. 181-99, with M. Aoki.

"An Optimal Control Model of Olive Inventories Using State Space Models," June 1989, *Proceedings of the 6th IFAC Symposium on Dynamic Modelling and Control of National Economies,* pp. 7-12, Edinburgh, U.K., With J. Dorfman.

"Deterministic and Stochastic Trends in State Space Models of Nonstationary Time Series," (University of California, Working Paper 90-9), June 1990, with M. Aoki.

"Not Quite a Revolution in Products Liability," Manhattan Institute Judicial Studies White Paper, 1990. [A column by Peter Huber in *Forbes* magazine in October 1990 was devoted to reviewing this paper, and it resulted in an interview on a video produced by the Manhattan Institute for Policy Research ("Liability: Injustice for All") narrated by Walter Cronkite.] An earlier expanded version titled "A Critique of 'The Quiet Revolution in Products Liability'," June 1990 (University of California, Agricultural Economics Department Working Paper 90-9) also received press attention.

"Forecasts from a State Space Multivariate Time Series Model," *American Journal of Agricultural Economics,* Vol. 72, No. 3, August 1990, pp. 793-798, with K. Criddle.

"Bayesian Forecasting with a Balanced Representation State Space Model," *American Statistical Association 1990 Proceedings of the Business and Economic Statistics Section,* pp. 79-88, with J. Dorfman.

"State Space Modeling of Multiple Time Series," *Econometric Reviews,* 1991, Vol. 10, No. 1, pp. 1-59 (lead article, most of the journal issue), with M. Aoki.

"Reply to Comments on State Space Modeling of Multiple Time Series," *Econometric Reviews,* 1991, Vol. 10, No. 1, pp. 93-96.

"State Space Modeling of Cyclical Supply, Seasonal Demand, and Agricultural Inventories," *American Journal of Agricultural Economics,* Vol. 73, No. 3, August 1991, pp. 829-840, with J. Dorfman.

"An Encompassing Approach to Modeling Fishery Dynamics: Modeling Dynamic Nonlinear Systems," *Natural Resource Modeling,* Vol. 5, No. 1, Winter 1991, pp. 55-90, with K. Criddle.

"Flooding on the Eel River: Systems Theoretic Time Series Versus Structural Model Forecasts," *Natural Resource Modeling*, Vol. 16, No. 2, Spring 1992, pp. 171-190, with J. Tracy.

"A Bayesian Approach to State Space Multivariate Time Series Modeling," *Journal of Econometrics*, Vol. 52, No. 3, June 1992, pp. 315-346 (lead article), with J. Dorfman.

"Multi-Market Arbitrage Using System Theoretic Time Series Forecasts," *Papers of the 1993 Annual Meeting, Western Agricultural Economics Association*, Edmonton, Alberta, July 1993, pp. 71-77, with K. Foster and A. Walburger.

"Improved Estimates of the Parameters of State Space Time Series Models," *Journal of Economic Dynamics and Control* Vol. 20, No. 5, May 1996, pp. 767-789, with Z. Leng.

"System Theoretic Forecasts of Weekly Live Cattle Prices," *American Journal of Agricultural Economics*, Vol. 77, No. 4, November 1995, pp. 1012-1023, with K. Foster and A. Walburger.

"Model Specification Tests for Balanced Representation State Space Models," *Communications in Statistics: Theory and Methods*, Vol. 24, No. 1, 1994, pp. 97-119, with J. Dorfman.

"A State Space Multivariate GARCH Approach to Modeling the Effects of Regulation on Telecommunication," *1995 Proceedings of the American Statistical Association, Business and Economic Statistics Section*, (invited paper), pp. 39-46, with Z. Leng.

"Demand Systems Estimation with Censored Microdata: Practical Estimators," July 1995, draft, with D. Heien and Z. Leng.

"Stochastic Production Function Estimation: Small Sample Properties of ML versus FGLS," *Applied Economics*, 1997, Vol 29, pp. 459-469, with A. Saha and H. Talpaz.

"The Economics and Econometrics of Damage Control," October 1995, *American Journal of Agricultural Economics*, Vol. 79, No. 3, August 1997, pp. 773-785, with A. Saha and R. Shumway. This paper was one of four finalists for best journal article of the year.

Applications of Computer Aided Time Series Modeling, 1997, M. Aoki and A. Havenner, editors (Berlin: Springer-Verlag).

"A Guide to State Space Modeling of Multiple Time Series," 1996, *Applications of Computer Aided Time Series Modeling*, M. Aoki and A. Havenner, editors (Berlin: Springer-Verlag 1997) Part I, Chapter 2.

"Evaluating State Space Forecasts of Soybean Complex Prices," 1994, *Applications of Computer Aided Time Series Modeling*, M. Aoki and A. Havenner, editors (Berlin: Springer-Verlag 1997) Part II, Chapter 1, with D. Berwald.

"Managing the Herd: Price Forecasts for California Cattle Production," 1995, *Applications of Computer Aided Time Series Modeling*, M. Aoki and A. Havenner, editors (Berlin: Springer-Verlag 1997) Part II, Chapter 3, with L. Egan.

"Is the Quality of Agricultural Products Guaranteed by Government Grades and Minimum Standards?" 1996, draft, with K. Weiss and R. Green.

"Dynamic Multiproduct Hedging Decisions for the Feedlot Operator," 1998, with Z. Leng.

"User Guide for SSATS 2.0 Procedure Module," 1996, distributed through Gauss with modules to do state space time series, with J. Dorfman.

"An Introduction to Model Specification and Estimation of Balanced Representation State Space Models," 1996, distributed through Gauss with modules to do state space time series, with J. Dorfman.

"Time Series Analysis of a Policy-Created Asset: The Case of California Dairy Quota," 1996, with N. Wilson and D. Sumner.

"Walnut Crop Forecasts," May 1996, Report to the Walnut Marketing Board.

"Walnuts in Japan: A Case Study of Generic Promotion under the USDA's Market Promotion Program," *1996*, in *Agricultural Commodity Promotion Policies and Programs in the Global Agri-Food System*, J. Ferrero, K. Ackerman, and J. Nichols editors, with K. Weiss and R. Green.

"Anlaysis of Welfare Dependence Using A New Duration Model," 1997, in review, with A. Saha and L. Hilton.

"Pistachio Crop Forecasts," July 1998, Report to the California Pistachio Commission.

"Cointegration and Settlement of Commodity Futures Contracts," *Macroeconomic Dynamics*, Vol. 3, No. 2, June 1999, with K. Foster.

"Agricultural Product Market Development by Grower Organizations," with K. Weiss and R. Green.

"Globally Flexible Asymptotically Ideal Models," *American Journal of Agricultural Economics*, Vol. 81, August 1999, pp. 703-710, with A. Saha.

"Asymptotically Ideal Models of Demand and Production," draft, 1999, with A. Saha.

"The Effect of Rate Regulation on Mean Returns and Non-Diversifiable Risk: The Case of Cable Television," *Review of Industrial Organization*, Vol. 19, 2001, pp. 149-164, with T. Hazlett and Z. Leng.

"The Arbitrage Mirage: Regulated Access Prices With Free Entry In Local Telecommunications Markets," submitted to the *Review of Network Economics* Special Issue on Incentive Regulation (2003), Dennis Weisman, ed,, with Thomas Hazlett.

ATTACHMENT 3

COLEMAN D. BAZELON, Ph.D.
Vice President

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EDUCATION

Ph.D. in Agricultural and Resource Economics, University of California at Berkeley, CA, 1995. Dissertation: *The Political Economy of California Water.*

M.A in Agricultural and Resource Economics, University of California at Berkeley, CA, 1989.

Diploma in Economics, London School of Economics and Political Science, London, England 1987.

B.A., College of Social Studies, Wesleyan University, Middletown, CT, 1986.

PROFESSIONAL EXPERIENCE

2001 – Present Vice President, Analysis Group Economics, Washington, D.C.

1995-2001 Principal Analyst, Congressional Budget Office, Washington, D.C.

PUBLICATIONS

Michael H Rothkopf and Coleman Bazelon, "Interlicense Competition: Spectrum Deregulation Without Confiscation or Giveaways," New America Foundation, *Spectrum Series Working Paper #8*, August, 2003.

Review of *Discounting and Intergenerational Equity*, by Paul Portney and John Weyant, Resources for the Future, 1999, in the Society of Government Economists Newsletter, Volume 34, No 10, November 2002.

"Next Generation Frequency Coordinator," *Telecommunications Policy*, 27 (2003) pp. 517-519.

"Why Federal Budget Estimates Should Assume Zero Tax Revenue Effects From Sales of Federally Owned Income Producing Assets," *Public Budgeting and Finance, forthcoming.*

Coleman Bazelon and Kent Smetters, "Intergenerational Discounting," *Loyola of Los Angeles Law Review*, Vol. 35, Issue 1, November 2002.

Coleman Bazelon and Kent Smetters, "Discounting Inside the Washington D C. Beltway," *Journal of Economic Perspectives*, Fall 1999

Completing the Transition to Digital Television, Congressional Budget Office, September 1999.*

Two Approaches for Increasing Spectrum Fees, Congressional Budget Office, November 1998 (Coauthored with David Moore*).

Where Do We Go From Here? The FCC Auctions and the Future of Radio Spectrum Management, Congressional Budget Office, April 1997 (Coauthored with Perry Beider and David Moore*).

"The Movement of Markets," *Wesleyan Economic Journal*, Spring 1986.

"Is the Psychogenic Theory of History Scientific?" *Journal of Psychohistory*, Fall 1985.

* CBO publications are not cited with the author's name.

SEMINARS AND PRESENTATIONS

Marketing & Legal Strategies: Hope, Hype & Crash Landings, WCAI 2003, Washington, DC, July 10, 2003.

Spectrum Policy Task Force Interference Recommendations, Manhattan Institute Conference, Washington, DC, February 13, 2002.

FCC License Auctions, Society of Government Economists Conference, Washington, DC, November 22, 2002.

Spectrum Management Panel, CTIA Wireless 2002, Orlando, FL, March 18, 2002.

A Note on Correlation, ASSA Annual Meetings, Atlanta, GA, January 6, 2002.

Regulatory Forbearance, Powerline Communications Conference, Washington, DC, December 13, 2001

Spectrum License Valuations, CTIA Wireless Agenda 2001, Dallas, TX, May 2001.

Old Spectrum in the New Economy, with David Moore, Invited paper, Society of Government Economists Conference "The New 'Economy': What Has Changed and Challenges for Economic Policy," Washington, DC, November 2000.

Discounting Inside the Washington DC Beltway, Energy Information Agency Seminar Series, Washington, DC, March 2000.

Discounting Inside the Washington DC Beltway, Congressional Budget Office Seminar Series, Washington, DC, November 1999.

Completing the Transition to Digital Television, Telecommunications Policy Research Conference, Arlington, VA, September 1999.

Digital Television Transition, Congressional Budget Office Seminar Series, Washington, DC, April 1999.

The Budgetary Treatment of Asset Sales, Briefing for the staff of the Senate Budget Committee, Washington, DC, February 1997.

The Value Added from Multilateral Bargaining Theory for Applied Research, with Greg Adams, Selected Paper, AAEA Annual Meeting, Baltimore, MD, August 1992.

The Importance of Political Markets in Formulating Economic Policy Recommendations, Selected Paper, AAEA Annual Meeting, Manhattan, Ks, August 1991.

LDC Debt and Policy Linkages in the Determination of World Commodity Prices, with Gordon Rausser, Selected Paper, AAEA Annual Meeting, Vancouver, B.C., Canada, August 1990.

TESTIMONY

"Spectrum Deregulation Without Confiscation or Giveaways," with Michael Rothkopf, Comment in the Matter of Issues Related to the Commission's Spectrum Policies (ET Docket No 02-135), January 9, 2003.

"Comments of Coleman D. Bazelon and T Christopher Borek Relating to Arthur D. Little, Inc.'s Assessment of the Impact of DTV on the Cost of Consumer Television Receivers," Ex Parte Communication to the Federal Communications Commission in the Matter of Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television (MM Docket 00-39), August 1, 2002.

"Use Administrative Law Judges to Adjudicate Interference Disputes Between Licensees," Comment in the Matter of Issues Related to the Commission's Spectrum Policies (ET Docket No. 02-135), July 8, 2002.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Petition for Forbearance From	)	
the Current Pricing Rules for	)	WC Docket No. 03-157
the Unbundled Network Element	)	
Platform	)	

DECLARATION OF THOMAS W. HAZLETT, PH.D., ARTHUR M. HAVENNER, PH.D., AND COLEMAN BAZELON, PH.D.

1. My name is Thomas W. Hazlett. I am a Senior Fellow at the Manhattan Institute for Policy Research, and a former Chief Economist of the Federal Communications Commission. Attachment 1 is a copy of my curriculum vitae.

2. My name is Arthur M. Havenner. I am a Professor of Agricultural and Resource Economics at the University of California, Davis. Attachment 2 is a copy of my curriculum vitae.

3. My name is Coleman Bazelon. I am a Vice President of Analysis Group, Inc. Attachment 3 is a copy of my curriculum vitae.

4. We have been asked by Verizon to analyze recent trends in telecommunications investment, and in particular the relationship between these developments and the use of the unbundled network element platform ("UNE-P") at TELRIC rates. We have also been asked to evaluate a recent study by the Phoenix Center that purports to show that the rise in the use of UNE-P has increased investment by incumbent local exchange carriers ("ILECs").

5. This declaration is organized as follows. Section I provides an introduction and summary of our findings. Section II demonstrates that telecommunications investment – by both incumbent and competitive carriers – has declined sharply in the past two years, and that available financial and economic evidence indicate that this is due in large part to the rise of the TELRIC-priced UNE-P. Section III demonstrates that the recent analysis by the Phoenix Center does not support the conclusion that increases in UNE-P lines have caused ILECs to increase investment.

I. Introduction and Summary

6. Investment in local wireline facilities, by both competitive and incumbent carriers, has recently declined in the United States. The decline is so substantial that it has reduced the capital stock of the major local telecommunications providers. While no one

factor explains the entire decline, a major contributing cause is the regulatory policy that enables competing carriers to resell the entire suite of an incumbent's network services at sharply discounted wholesale rates. From year-end 2000 through 2002, such resale – known as the UNE platform or UNE-P – increased by more than 200 percent, from 2.838 million lines to 10.225 million.[1]

7. There is abundant evidence from the marketplace that the decline in wireline investment is due in substantial part to the rise of UNE-P. This causality is supported by the pattern of investment taking place in the sector as compared with other sectors, the reaction of facilities-based competitors to UNE-P, and the wide consensus among investment analysts and telecommunications technology suppliers that the expanding use of UNE-P threatens capital expenditures on network assets.

8. A recent paper by the Phoenix Center presents the results of an econometric study that, it argues, support an alternative view. The paper asserts that UNE-P's rapid growth has abbreviated the fall in investment by the Bell Operating Companies (BOCs), which is entirely (or more than entirely) attributable to other factors. Neither the models estimated, nor the conclusions reached, hold up under careful scrutiny, which reveals their central finding to be wholly the product of spurious correlation. This is demonstrated by the fact that three alternative models of the relationship between investment and UNE-P that correct Phoenix's methodology produce sharply contrasting results. If the Phoenix models accurately estimated the true relationship, we would not expect these alternative models to negate their results.

II. The Decline of Telecommunications Investment

9. In this section, we first describe ways to measure investment in wireline telecommunications. We then demonstrate that, under any appropriate measure, investment in wireline telecoms has declined in recent years, both for incumbent local exchange carriers and competing local exchange carriers. Finally, we demonstrate that one of the primary causes for this decline is the regulation requiring wholesale access to the UNE platform at TELRIC rates. We show, for example, that the investment decline is most marked in telecommunications segments where unbundling policies have been most aggressive. While investment flows have slowed for wireless and cable – which are both subject to many of the same market forces as local wireline markets but are free of the regulatory burdens imposed on ILECs – both have outperformed incumbent telephone companies in continuing to attract investment capital.

A. Measuring Telecommunications Investment

10. There is some debate about the proper measure of investment in the telecommunications industry. To avoid confusion, it is important to define terms. To economists, *investment* refers to the creation of new productive assets. Investment expenditures cause *capital stock* – approximated in telecommunications networks by the

[1] FCC, Local Telephone Competition: Status as of December 31, 2002, at Table 4 (June 2003).

total book value of plant and equipment – to rise. By contrast, *depreciation* refers to the wearing out of old capital, which causes capital stock to fall. Each year, capital stock may change depending on the relationship between new investment and depreciation. For example, if new investment exceeds depreciation, capital stock will rise. *Gross capital stock* is total capital stock before subtracting depreciated capital, whereas *net capital stock* is total capital stock after subtracting depreciation.

11. *Economic depreciation* is distinguished from *accounting depreciation.* Economic depreciation is the amount of capital actually consumed; accounting depreciation, by contrast, is the amount of capital that is theoretically consumed pursuant to a depreciation schedule consistent with accounting principles, tax law, or regulatory guidelines.

12. Because all capital goods, such as telecommunications equipment, depreciate, investment is required to maintain capital stock at constant levels. Put differently, if investment falls below the level of economic depreciation, capital stock will fall and, consequently, output (adjusted for quality) will fall. In capital-intensive and high-technology industries, the amount of capital investment required merely to maintain the level of capital stock is typically very large. Investment analysts estimate, for example, that the maintenance level of investment for the local wireline telecommunications industry is approximately 15 to 20 percent of revenues, which represents an average of about $20 billion per year.[2]

13. Economists distinguish between the investment required to maintain capital stock and other investment. Investment that merely replaces depreciated capital does not lead to expanded output or productivity but just maintains the status quo. In contrast, investment above this maintenance level increases the net capital stock and creates the potential for future gains in productivity. *Gross investment* is a measure of capital expenditures that includes this maintenance level of investment. Gross Investment is equivalent to the change in Gross Capital Stock. *Net investment* is a measure of capital expenditures that subtracts this replacement capital. The investment analyst community typically focuses on gross investment for the companies they cover, calling it "capital expenditures" or "cap ex."

14. One principal source of data on investment by incumbent local exchange carriers in their regulated lines of business is the FCC's ARMIS database.[3] ARMIS provides information enabling calculation of some of the variables described above. First, ARMIS provides the gross capital stock of each of the larger ILECs, including the BOCs. This is reported in ARMIS as *Telecommunications Plant in Service* or *TPIS.* TPIS is the total book value – before depreciation – of central office switching assets, central office transmission assets, information origination and termination assets, cable and wire facilities, operator systems, general support assets, and amortizable assets. ARMIS reports TPIS by Company Study Area (a "COSA"). Some COSAs correspond to

[2] Skyline Marketing Group reports that the maintenance level for Regional Bell Operating Company investments is 15-20 percent (CapEx/Rev). Skyline Marketing Group, *CapEx Report: 2002 Annual Report,* June, 2003, p. 8.

[3] http://www.fcc gov/wcb/armis/overview.html.

operations within a single state, while other COSAs are an aggregation of state COSAs and cover operations in multiple states.[4]

15. Second, ARMIS contains a category called *Additions to TPIS* that approximates gross investment. This represents the book value of capital investments at their time of purchase. This category is closely related to what investment analysts term cap ex.

16. Third, ARMIS contains a category called *Average Net Investment* that is TPIS adjusted for "Other Investment" and "Reserves."[5] Contrary to what its name implies, this category does not represent an investment flow, but something close to net capital stock. Therefore, the change in *Average Net Investment* in any given year is a rough measure of what economists call net investment.[6]

B. The Decline of Wireline Telecom Investment

17. Investment by wireline local exchange carriers is down sharply not only from the highs of 2000 and 2001 but also from historic averages. According to a recent report by Skyline Marketing Group, the amount of annual gross investment by wireline telecommunications carriers (both local and long distance) declined from $104.8 billion in 2000 to $42.8 billion in 2002 – a reduction of over $60 billion in just two years.[7] According to the Telecommunications Industry Association, spending by carriers on telecommunications equipment (one crucial component of network capital) decreased from $58 billion in 2000 to $22 billion in 2002.[8] Independent analysts doubt U.S. wireline investment for 2003 and 2004 will significantly rebound.[9]

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[4] For example, BellSouth's nine-state region forms a single COSA (KY, TN, NC, SC, GA, AL, MI, LA, FL), as does the five-state Ameritech region owned by SBC (WI, IL, IN, OH, MI), the five-state Southwestern Bell Telephone region owned by SBC (TX, OK, KS, AK, MO), the two-state Pacific Bell region owned by SBC (CA, NV), and the five-state New England Telephone region owned by Verizon (MA, ME, NH, RI, VT)

[5] Other investment includes "other jurisdictional assets," "property held for future telecommunications use," "telecommunications plant under construction," "plant acquisition adjustment," "investment in nonaffiliated companies," "other deferred charges," "inventories," "cash working capital," and "FCC investment adjustment." "Reserves" is the sum of "Accumulated Depreciation", "Accumulated Amortization", "Deferred Operating Income Taxes", "Customer Deposits", "Other Deferred Credits", "Other Long-Term Liabilities", "Deferred Tax Liabilities", "Other Jurisdictional Liabilities and Deferred Credits", and "FCC Reserve Adjustment." ARMIS Report 43-01 Instructions. Available at http://www.fcc.gov/wcb/armis/instructions/2002/definitions01.htm#T1R.

[6] A complication is that one component of "Reserves" is accounting depreciation. Economic depreciation is not reported in ARMIS. Reserves also includes a number of items that are not directly related to network investments, such as Deferred Tax Liabilities and Other Long-Term Liabilities.

[7] *See* Skyline Marketing Group, *CapEx Report: 2002 Annual Report*, Carrier Data Sheet 1, June, 2003.

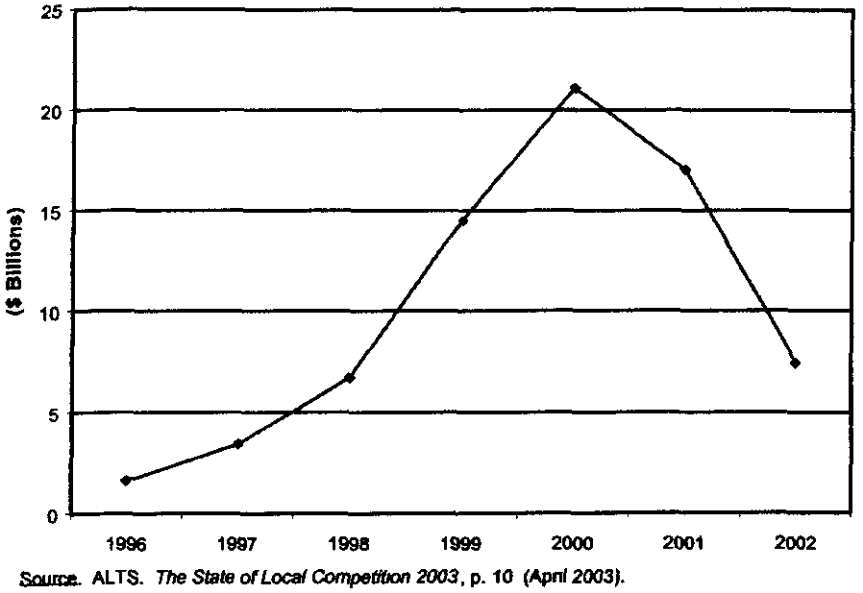
[8] TIA, *2003 Telecommunications Market Review and Forecast* at 56 – Tables II-4.1 & II-4.2 (2003). Spending by carriers on telecommunications equipment decreased by 26.2 percent in 2001 (from $58B to $43B) and by 49.1 percent in 2002 (from $43B to $22B).

[9] See, e.g., Soundview Technology Group, "Wireline Communications Services: Sector Capital Expenditure Update," May 1, 2003; J. Parmelee, Telecom Equipment – Wireline Update, Credit Suisse First Boston, September 26, 2002; Deutsche Bank Securities Inc., U.S. Wireline Services, "RBOCs: Initiating Coverage", November 22, 2002. Investment analysts are not optimistic. One reports, "...we

18. The decline in overall telecom investment reflects a decrease in spending by both competitive local exchange carriers (CLECs) and incumbent carriers (ILECs). In both cases, current levels of gross investment are below not only the peak-years of 1999-2001, but also below previous levels when measured in the standard way, which is cap ex as a percent of revenues.

19. Gross investment by both private and public CLECs fell by 39 percent from 2000 to 2001, and by an additional 81 percent from 2001 to 2002.[10] According to ALTS, a CLEC trade association, capital expenditures by the subset of publicly traded, facilities-based CLECs decreased by 19 percent from 2000 to 2001, and by 56 percent from 2001 to 2002. See Figure 1. As a percentage of revenues, the decline for these CLECs was even greater – 71 percent from 2000 to 2002. See Figure 2. Under this measure, CLEC investment has plummeted to about one-quarter its level in 1999-2000.

Figure 1
CLEC Gross Investment

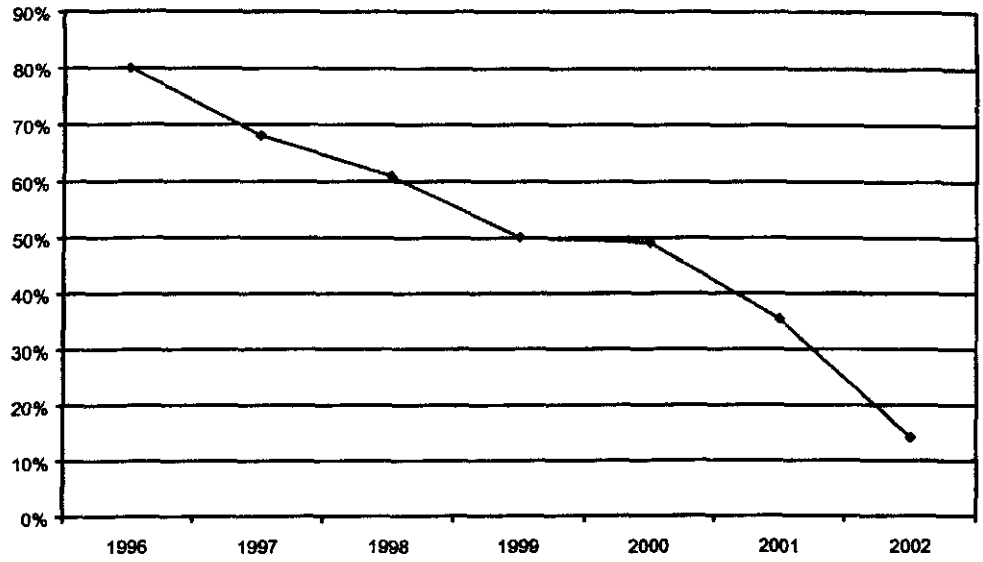


Source. ALTS. *The State of Local Competition 2003*, p. 10 (April 2003).

would expect the total level of US wireline spending, which approximates $36 billion for 2003, down from roughly $110 billion in 2000, will remain at these depressed levels for some time." Fulcrum Global Partners, *Wireline Communications· Thoughts on FCC Order*, February 25, 2003. Another analyst is even more pessimistic· "Precursor doubts that **wireline telecom capex will meet guidance for '03 or expectations for '04**....Telecom has not bottomed; it is not even close....We project that wireline capex is trending towards ~$23b for the year, significantly below guidance of ~$28b-$30b." Precursor Group, *Wireline Telecom Capex Guidance Is Likely Too Optimistic*, August 8, 2003 (emphasis in orginal).

[10] *See* Skyline Marketing Group, *CapEx Report· 2002 Annual Report*, Carrier Data Sheet 1, June, 2003.

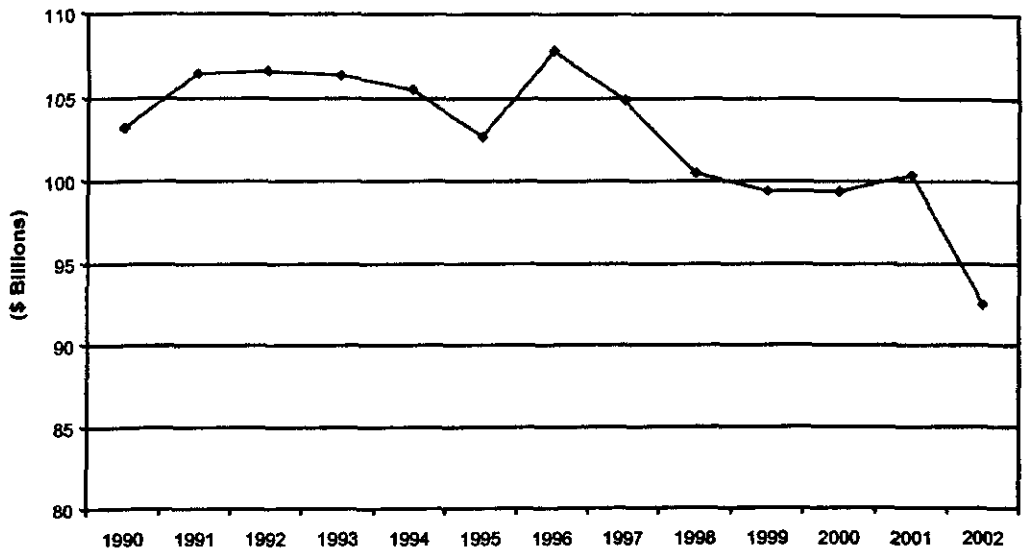
Figure 2
CLEC Gross Investment as a Percentage of Revenue



Source. ALTS: *The State of Local Competition 2003*, pp. 8, 10 (April 2003)

20. There has also been a significant decline in investment by incumbent local exchange carriers. Figure 3 shows the net capital stock of BellSouth, SBC, and Verizon from 1990 through 2002. (The remaining Bell Operating Company, Qwest, has not yet reported its 2002 numbers.) While net capital stock appeared to rise during the last of the Internet boom, it was a relatively minor uptick, and substantial disinvestment appears to be taking place since. Net capital stock of these Bell companies is down approximately 12 percent – $13 billion – since enactment of the 1996 Telecommunications Act.

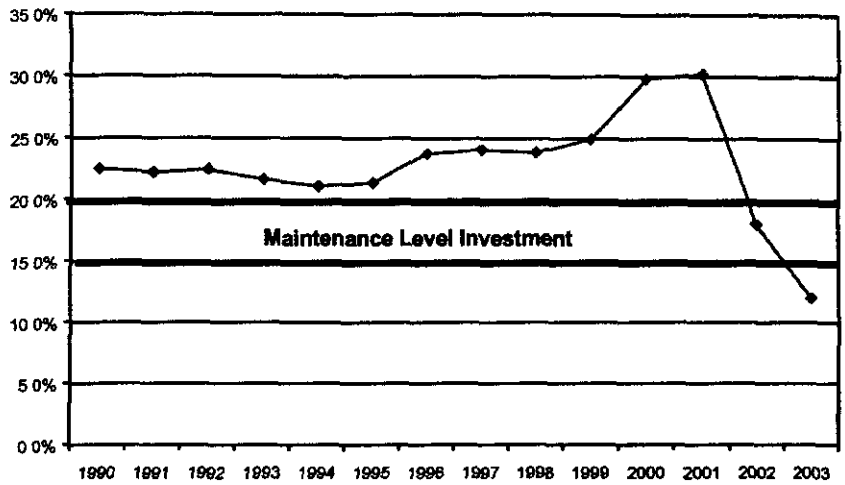
Figure 3
Net Capital Stock
Verizon, Bell South, SBC



Source: FCC Report 43-01 (ARMIS); "Average Net Investment, Subject to Separations "

21. Not surprisingly, the period has seen a marked reduction in annual capital expenditures. As demonstrated in Figure 4, for example, annual gross investment by the Bell companies has declined significantly as a percentage of BOC revenues. By that measure, gross investment has declined not only below the years of peak investment in 2000 and 2001, but is also below any level seen in a decade.

Figure 4
RBOC Wireline Investment Spending As A Percentage of Revenue



Source. Data represent "Telecommunications Plant in Service Additions" as a percent of "Total Operating Revenues, Subject to Separations" FCC Report 43-01 and 43-02 (ARMIS)
*2002 is from *CapEx Report: 2002 Annual Report*, SkyLine Marketing Group, June 2003, p 18
**2003 is Q1 2003 estimate from *"Telecom Disconnect" Quality of Bell Free Cash Flow Worsening, Precursor Group, July 21, 2003*

22. Figure 4 shows that, in 2002, BOC capital spending was just at maintenance level, and that it is now falling beneath it in 2003. This implies that the networks owned by these companies will not be enhanced to provide for greater productive activity. Indeed, it suggests that the leading local exchange networks could stagnate or decline in functionality. As investment analysts have recognized, there are potentially serious consequences for consumers when cap ex spending goes below maintenance levels. Morgan Stanley cites the experience of Ameritech, which reduced its cap ex to sales ratio to 13.7% in 1994 and 1995. "Service quality complaints filed with state regulatory authorities ramped significantly from 15 per 1 million access lines in 1994 to 1,044 per million in 2000 by the time the [acquisition by SBC] was closed." [11]

C. Evidence that the Decline in Telecom Investment is Linked To The Rise in TELRIC-Priced UNE-P.

23. Although there has been much contentious debate over the effects of the telephone network unbundling rules on investment incentives, there is one area of clear consensus: financial analysts widely believe that the rational strategy under the current regulatory regime is for local phone companies to slash capital expenditures. As financial analysts have repeatedly found, one important factor making telecommunications investments uneconomic (for both incumbent and competing carriers) is the prospect that UNE-P line growth will ramp up. The available evidence supports this conclusion.

[11] Morgan Stanley, "Wireline Telecom Services Trend Tracker: Nowhere to Hide," March 3, 2003, p. 52.

24. This is seen in cable telephony. The cable TV industry passes 97 percent of U.S. households[12] with a wire capable of delivering competition to local exchange carrier networks. Cox Cable maintains that cable systems can profitably upgrade their local networks to offer voice service, investing about $610 per subscriber[13] to realize 35% cash flow margins on monthly revenues averaging $50 per customer per month,[14] attracting forty percent market share in just a few years.[15] Three years ago, several large cable companies were investing in cable telephony. But, with the emergence of high UNE-P line growth, AT&T Broadband, Comcast (now owner of AT&T Broadband), and Cablevision pulled back from construction of rival networks, Cox being the one major system operator to continue its build-out uninterrupted. As they have for several years, cable operators continue to monitor the progress of IP telephony, with some planning to take advantage of this facilities-based strategy in the near future.[16] But, UNE-P threatens to undercut investors in competitive facilities. Cox Cable argues to "[s]hift the FCC's focus away from CLEC resale and UNE models... toward facilities-based competition."[17] As Legg Mason noted in a recent appraisal of cable TV system assets, "UNE-P reduces [the] voice opportunity."[18]

25. Data from the FCC also show that UNE-P growth is coming at the expense of facilities-based competition. As UNE-P lines grew over 200% in the 2000-2002 period, facilities-based competitive lines grew just twenty-three percent – a substantial slowing from their previous trend. The number of facilities based non-cable lines *decreased* from 4.1 million at the end of 2000 to 3.4 million by the end of 2002.[19] The correlation between UNE-P lines and non-cable facilities based lines is almost a perfect –1 (-.99685), meaning that UNE-P line growth has been accompanied by a simultaneous reduction in facilities-based competitive lines period by period. The negative relationship between UNE-P lines and facilities based competitive entry is also evident in a simple regression analysis we performed. It predicts that every new UNE-P line is associated with about 0.12 fewer facilities-based competitive lines.[20]

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[12] FCC, Ninth Annual Report on the Status of Competition in the Market for the Delivery of Video Programming, MB Docket No. 02-145 (Dec. 31, 2002), at Table 1.

[13] Cox Communications, White Paper: Preparing for the Promise of Voice-over Internet Protocol (VoIP) Feb. 2003, p. 6.

[14] Cox Communications, Inc., The Winning Strategy: Positioning US for Future Growth, presentation by Chris Bowick, Senior VP, Engineering and CTO, Lehman Brothers Conference, May 2003.

[15] Merrill Lynch, Cable Telephony Update, Feb. 21, 2003, p. 2.

[16] Alan Breznick, "Small MSOs Make Initial Moves into VoIP Service," Cable Datacom News, July 2003.

[17] Testimony of Jim Robbins, CEO, Cox Communications, Before the Senate Judiciary Subcommittee on Antitrust, Business Rights and Competition, May 2, 2001.

[18] Legg Mason, Washington Telecom and Media Insider, Feb. 21, 2003.

[19] Federal Communications Commission, "Local Telephone Competition: Status as of December 31, 2002," June 2003.

[20] We regressed the number of non-cable CLEC-owned access lines against a constant term and the previous period's number of UNE-P lines. The data were semi-annual from the second half of 1999 through the end of 2002. The regression coefficients were significant at the 95% confidence level, and they explain 90% of the growth in the facilities based lines (adjusted R-squared = 0.9036).

26. Second, the evidence demonstrates that the decline in investment by incumbent local exchange carriers has been caused to some substantial degree by current regulatory policies. Since the emergence of substantial UNE-P line growth in 2000, the simple correlation between UNE-P lines and Bell Operating Company (BOC) investment is –0.94, indicating a strongly negative relationship.[21]

27. Financial analysts also view the current regulatory structure as strongly anti-investment. This is an important source of information, in that analysts evaluate financial opportunities for investors. Analysts are typically objective in the sense that they have no preference for one industry over another, but seek to understand how economic and regulatory factors affect future returns. They view UNE-P as a negative for both RBOC investors and the entire telecommunications industry.[22] The continuation of UNE-P at current TELRIC pricing is seen as detrimental to telecommunications investment.[23] Telecommunications networks are seen to be decreasing invetment in direct response to wholesale price regulation. As Merrill Lynch reports, "SBC continues to be the RBOC with the worst retail to UNE-P line migration."[24] At the same time, SBC is cutting gross investment most aggressively.[25]

28. Under the current regulatory structure, analysts note that decreasing investment is not just correlated with UNE-P, but the smart thing for BOCs to do. One "Bright spot" for the investment analyst community following the first quarter of 2003 was that

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[21] The correlation coefficient measures the degree to which two variables move together. A correlation coefficient of –0.94 implies that when one of the variables, say UNE-P lines, increases, the other variable, in this case gross BOC investment, decreases The coefficients can vary between –1 and 1; positive means they move in the same direction; negative means they move in opposite directions; the closer to either 1 or –1, the stronger the relation.

[22] "*How the FCC Decision Depresses Overall Equipment Demand.* Precursor believes the FCC's decision to invigorate/extend UNE-P resale competition will likely pressure core telecom equipment spending. . . . (1) Increasing profit pressure forces Bell capex cuts. . . . (2) Enables AT&T and WorldCom to cut current capex to fund UNE-P marketing. Preserving UNE-P for at least four years and making it available to more of the small business market encourages AT&T and WorldCom to swap capex for more UNE-P marketing in order to improve cash flow and profitability short-term. (3) Increases capital investment risk and uncertainty. . . . (4) Increases necessity of Bell-LD consolidation, reducing capex spending. Given that the government is artificially forcing down local profits, consolidation to achieve cost savings may be the only way to preserve some Bell shareholder value." Precursor Group, *FCC Decision Accelerates Dis-investment and Shifts Equipment Demand*, March 4, 2003 (emphasis omitted).

[23] "The FCC... increased its anti-investment bias by favoring resellers over infrastructure owners and equipment suppliers." Scott Cleland, Precursor Group, *Precursor Returning to Negative Telecom Outlook As FCC Invigorates UNE-P*, February 24, 2003 (emphasis omitted).

[24] Merrill Lynch, *SBC Communications*, Comment, April 29, 2003, p. 2. See also, UBS Warburg, "How much Pain from UNE-P?" August 20, 2002: "SBC has lost more retail lines to UNE-P than any other Bell..." and "SBC takes the hardest hit for retail lines lost to UNE-P...", p. 27.

[25] Precursor Group, "Telecom Disconnect: Quality of Bell Free Cash Flow Worsening", July 21, 2003: "Among the Bells, SBC has been most aggressive in propping up FCF [free cash flow] with CapEx cuts, followed by BLS and VZ, respectively."

"practically every telco reported capex well below our expectations."[26] One firm notes that with SBC's cap ex to revenue ratio at 9%, there is little room for further cuts, while Bell South and Qwest "still have some room to cut" at 11% and 12%, respectively, and Verizon at 15% "is likely best positioned to cut."[27] As RBOC capital spending falls below maintenance levels, financial analysts are hoping to see *deeper cuts*.[28] Morgan Stanley adds that "[a]s the Bells approach spending of at historical [low] mid-teens percentage of sales levels, we do not believe that we have yet witnessed a bottoming of capex. If conditions worsen and UNE-P persists, we would expect more capex cuts across the board."[29]

29. Some argue that the pattern of telecom investment reflects only the standard leveling off experienced after a period of rapid expansion.[30] While it is true that the opportunities created in the Internet boom, including heightened demand for high-speed data services by both consumers and businesses, attracted investors to provide capital for telephone network infrastructure, this does not explain current trends. The net capital stock owned by RBOCs did not rapidly expand in the boom period, and it is not now leveling off but *declining*. In contrast, other U.S communications sectors – such as wireless and cable – expanded their net capital stock at a high rate, and have responded to post-boom conditions by reducing growth but maintaining capital infrastructure.

30. Figure 5 shows the net capital stock for leading "pure play" firms in wireless telephony, cable TV, and satellite TV, along with the RBOCs.[31] Although the growth of capital stock in these other sectors has flattened, in contrast to the wireline sector, capital stock is not declining. This is true despite the fact that these sectors all experienced rapid expansion in the boom phase of the current cycle, while the BOCs did not.

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[26] Merrill Lynch, *ILEC Scorecard*, May 15, 2003, p. 2.

[27] Precursor Group, "'Telecom Disconnect': Quality of Bell Free Cash Flow Worsening," July 21, 2003.

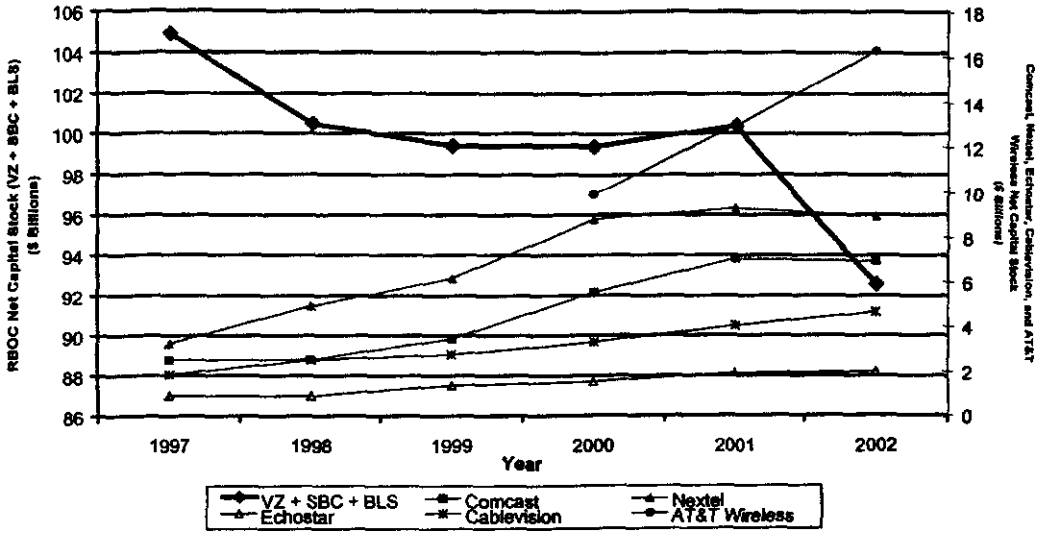
[28] "[W]e would not be terribly surprised to see additional cuts from our nation's largest carriers, as they react to this current FCC order. If these companies are charged with the fiduciary responsibility of the underlying shareholders, at some point it will be more responsible for the companies to begin returning cash flows to shareholders in the form of large dividends or share buy backs, rather than deploying capital into the network to generate negative returns for equity and debt holders." Fulcrum Global Partners, *Wireline Communications· Thoughts on FCC Order*, February 25, 2003.

[29] Morgan Stanley, Wireline Telecom Services, *Trend Tracker Nowhere to Hide*, March 3, 2003, p. 7.

[30] See Phoenix Center Policy Bulletin No. 5, "Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P," July 9, 2003.

[31] These firms are AT&T Wireless and Nextel (wireless telephony); Comcast and CableVision (cable TV), and EchoStar (satellite TV). By focusing on pure plays, it is possible to see the financial picture across different industries. Firms investing in multiple markets typically do not break out capital assets, and so company data offer an unclear picture of the trends in any one industry.

Figure 5
Net Capital Stock

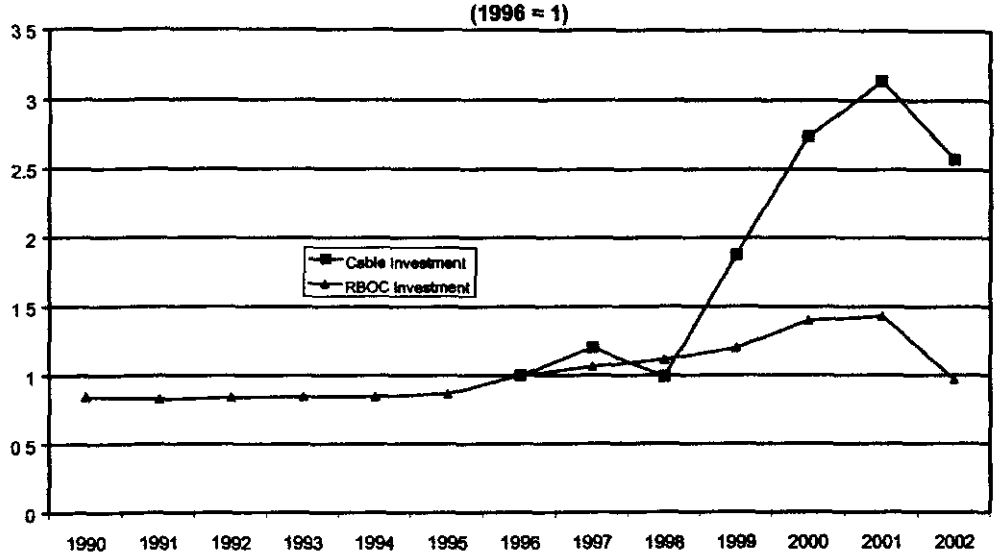


Source: Data from company 10-Ks

31. Similarly, the cable industry has not reduced its capital stock despite the fact that it, too, has now largely completed a major upgrade of its facilities nationwide. Even after building out two-way digital infrastructure for the delivery of digital video and cable modem service, investment remains at historically high levels. As Figure 6 shows, cable cap ex is much higher than that for the RBOCs, adjusting for their level of investment in 1996.[32] Similarly, satellite television companies spent substantial sums to create distribution platforms in recent years, and continues to increase net capital stock now.

[32] While widespread growth of UNE-P has discouraged cable telephony upgrades, the cable industry has been successful in opposing "open access" mandates for video and cable modem service, the two markets in which local cable operators are dominant, and which provide the vast majority of industry revenues.

Figure 6
Normalized RBOC and Cable Capital Investment
(1996 = 1)



Source. Cable investment represents "Cable Industry Infrastructure Expenditures," from Cable & Telecommmunications Industry Overview 2003 Mid-Year; NCTA RBOC investment represents "Plant Added" to "Telecommunications Plant in Service" for Verizon, SBC and BellSouth, from FCC Report 43-02 (ARMIS)

III. The Phoenix Center Econometric Analysis of the Investment/UNE-P Relationship

32. Contrary to the consensus prevailing in the investment community that UNE-P regulatory policies are deterring investment, a recent study by the Phoenix Center claims that statistical evidence shows a strongly positive correlation between UNE-P lines and investment by incumbent local exchange carriers.[33] While conceding that BOC net capital stock decreased by 7 percent from 2001 to 2002, the paper argues that, but for the rise of UNE-P, the decline in net capital stock would have been even greater (13 percent). The study claims that "each UNE-P access line increased BOC average net investment by $759 per year."

33. Before addressing other aspects of the analysis, we note that the magnitude of the estimated effect ($759 per UNE-P line) is implausible. The entire net capital stock of the BOCs is currently about $106 billion, or approximately $681 per line.[34] According to the

[33] Phoenix Center Policy Bulletin No. 5, "Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P," July 9, 2003.

[34] We estimate $106 billion by summing the SBC, Bell South, and Verizon net capital stock data from ARMIS for 2002 and adding 15%. (We add 15% because that was Qwest's average for the previous three years. We cannot use Qwest's data from ARMIS for 2002 because it is not reported yet.) The FCC reports

Phoenix study, each UNE-P line results in additional BOC investment exceeding this amount.[35] Put differently, the Phoenix study asserts that a BOC spends more than six times its annual average expenditure per line (about $123)[36] for each line it loses to UNE-P, and that it spends this amount in just six months after losing the line.[37] If true, the magnitude of this effect surely would be noticed by independent observers that have a direct stake in such an outcome. But this has not occurred. Indeed, not only is there a consensus among investment analysts that aggressive UNE-P pricing policies reduce investment, telephone equipment suppliers share the same view. As one large infrastructure supplier recently told the FCC:

> While Alcatel agrees with the Commission that competitive access to UNEs can help initiate competition in the local telecommunications market, it is concerned that over-reliance on the ILECs' network elements retards sustainable competitive growth and precludes many of the benefits associated with facilities-based deployment, such as investment, innovation, and redundancy. ... Aggressive unbundling and pricing rules can create perverse economic incentives for competitive telecommunications carriers to rely on the incumbents' network and a disincentive for the incumbent to improve on these facilities.[38]

34. In addition, as described in more detail in the Appendix, the methods used in the Phoenix study violate sound economic reasoning. First, the analysis does not account for key differences among states. For example, it fails to properly adjust for the fact that states differ considerably in size, in one model by effectively ignoring small states, and in the other by assigning small states disproportionately large weight. The study also fails to account for differences in economic climates and regulatory policies among the states that significantly affect carriers' willingness to invest. Similarly, there is no adjustment made for inter-firm differences, such as the cost of capital, which likewise vary among states. Second, the Phoenix study's claim that UNE-P increased investment is based on its model's forecast that, while the BOCs' capital stock fell by 7 percent in 2002, it would have fallen by 13 percent but for the increase in UNE-P lines. The Phoenix study reaches this result because it incorrectly assumes that firms instantaneously adjust capital infrastructure to desired levels. In fact, investments are implemented gradually, not all at once. This is particularly true when firms are reducing capital stock, the pace of which is

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179 million total lines in 2002. FCC Local Telephone Competition: Status as of December 31, 2002. At the end of 2001, the BOCs served 86.97% of all loops. FCC Study on Telephone Trends, August 2003. Assuming the same percentage in 2002, BOCs would have served 155.7 million lines. $106 billion/155.7 million = $681 per line.

[35] In fact, the Phoenix results suggest that if all BOC lines were converted to UNE-P, the net capital stock of the BOCs would double.

[36] Skyline Marketing reports 2002 BOC capex as $19.2 billion. 2002 BOC lines are estimated at 155.7 million (see footnote 35 above). $19.2 billion/155.7 million = $123 per line.

[37] This assumes that UNE-P lines are leased at a uniform rate throughout the year.

[38] *Comments of Alcatel USA, Inc* In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, CC Docket No. 01-338, pp. 9-10.

limited by depreciation rates and regulatory constraints such as universal service obligations. By omitting any consideration of how investment responds over time, and how that response may differ when investment is contracting, the Phoenix model over-predicts the BOC investment decline. It is this over-prediction of the decline in BOC investment that produces a positive "surprise." The Phoenix study then allows just one variable to account for this "increase" in investment, UNE-P line growth. The correlation is simply a construction of the model.

35. In fact, the Phoenix results are contradicted by those produced by other, equally (or more) appealing models evaluating the same or similar data. In the Appendix, we present the results of three alternative models, each of which corrects for certain errors in the Phoenix models. These alternatives are not offered to measure the actual empirical *relationship* between BOC investment and other variables. Instead, they assess the validity of the Phoenix model to explain the data reliably. If the estimates of the Phoenix regressions were valid, these alternative models should not contradict them. But they do.

36. In the first alternative model, we demonstrate that, by making individual BOCs the *focus* rather than state-level BOC units, the effect of UNE-P on investment is statistically significant and *negative*. In the second model, we show that merely by correcting statistical errors in the Phoenix models and by allowing firms to invest over time (rather than all at once), the statistical correlation between UNE-P lines and BOC investment disappears. In the third model, we include a variable to adjust for the cost of capital. This likewise eliminates the statistical significance of an effect of UNE-P on investment. Based on the evidence, therefore, we conclude that the economic relationship between UNE-P and BOC investment estimated by the Phoenix Center paper is the simple artifact of one, uncompelling model. When the data used in the Phoenix study are properly evaluated with more realistic models, they provide no evidence that UNE-P causes BOC investment to increase.

37. This concludes our Declaration.

APPENDIX

An Economic Analysis of Phoenix Center Policy Bulletin No. 5,
Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P (July 9, 2003)

A. Phoenix Center Results

1. The Phoenix Center study conducts a regression analysis using two models in an attempt to measure the relationship between UNE-P lines and investment by incumbent phone companies. Both models rely on data reported at the state level for the years 2000 to 2002; using annual changes reduces the analysis to two time periods.[1] Both models calculate investment as the annual change in net capital stock, which they explain with a constant term and three independent variables: the contemporaneous change in annual state revenues by the BOC; the contemporaneous change in UNE-P lines in the BOC's in-state territory; and a "dummy" variable indicating whether or not the observation is from the second period (2001 – 2002). Both models look at annual changes for each variable from 2000 to 2001 (28 observations), and from 2001 to 2002 (24 observations). The difference between the two models is that Model 1 looks at these values in absolute terms, while Model 2 divides the dependent variable (net capital stock) and two of the explanatory variables (Revenues and UNE-P lines) by BOC access lines in the state.

Table A1
Phoenix Center Model 2

Dependent Variable: Annual change in net capital stock per BOC line
Sample: 2001, 2002
Number of observations = 52

Variable	*Coefficient*	*Standard Error*	*P-value*
Constant	-13.34182	11.00852	0.2315
Annual Change in Revenue per in-state BOC line	0.423362	0.284543	0.1433
Annual Change in UNE-P lines per in-state BOC line	759.0850	298.1519	0.0142
2002 Dummy	-70.93738	15.90493	0.0000
Adjusted R-squared	0.443171		

2. The Phoenix study's results for Model 2 (which the paper recommends over Model 1) are summarized in Table A1. The result is that each additional UNE-P line is associated with an immediate increase of $759 in gross investment by the competing BOC within the state where the UNE-P line is offered (shown in Table A1 as the coefficient on "Annual Change in UNE-P lines per in-state BOC line" of 759.0850). The study reports a P-value of .0142 for the estimate, which means that, *given that the assumptions of the model are valid*, we would expect to see a coefficient this large by chance alone only 1.42% of the time. The model is not robust, however, meaning that it does not produce similar results when it is applied to a similar set of facts, or when its assumptions are made somewhat more realistic. One simple example is instructive. The Phoenix study

[1] The dataset excludes lines in Qwest and GTE service areas where UNE-P data were withheld for competitive reasons.

uses investment and revenue data as of December each year, while UNE-P lines are measured in June. Significantly, using all data from December (investment, revenue and UNE-P lines) in either Phoenix model eliminates the statistical significance of the change in UNE-P lines on investment.

B. Errors in the Model

3. The Phoenix model is designed to predict BOC investment spending state by state, yet it does not account for key differences between the states that may influence investment. At least three differences are likely to be important. First, the study fails properly to account for the fact that states differ considerably in *size*. Statistically, the data for each state should be weighted by the number of lines in the state. To do otherwise overemphasizes either the large states or the small states, invalidating statistical tests. Phoenix's Model 1 effectively ignores small states, which undermines the rationale for using state-level data in the first place. Phoenix's Model 2 does make an adjustment by dividing *some* variables by the BOC's in-state line count. But this adjustment is made selectively; the data associated with the constant and dummy terms are not divided by BOC lines. Neither approach is statistically valid.

4. Second, the study fails to account for differences in *economic climates* among states. Suppose that a given state is expected to see especially high economic growth over the next decade. That state might well be attractive to both ILECs and CLECs, which believe that profits will be easier to achieve where economic growth is higher, other factors equal. In response to the economic climate forecast, ILEC investments are made and CLECs begin more aggressively selling UNE-P lines. In this case, the correlation between investment and UNE-P lines would be positive, but there would be no causality: the UNE-P lines did not create the investment growth.

5. Third, the study fails to account for differences in *regulatory policies* among states. In places where taxes are expected to be less, for instance, firms might be more willing to invest in telecommunications or be more interested in marketing UNE-P lines. Other policies include the level of regulated retail prices for local telecommunications service. In states with higher retail rates, ILECs may respond by investing more, while entrants may respond by seeking to provide more UNE-P lines. Again, however, while the correlation between investment and UNE-P lines would be positive, there would be no causality: the UNE-P lines did not create the investment growth.

6. Another problem with the Phoenix model is that it is tested against only state-level data, rather than company-level data (i.e., data for each BOC as a whole). As we show below, when company-level data are used, the results are the reverse of what Phoenix obtains. This alternative approach demonstrates that increases in UNE-P lines are associated with a statistically significant *reduction* in BOC investment.

7. An even more fundamental set of problems with the Phoenix models arises from their treatment of the timing of investments. Large-scale capital structures like telephone networks are not created all at once. Investment projects such as these have planning and

implementation cycles that typically span several years. To account for this, economic models of investment typically include lagged variables (bringing in data from previous periods). The failure to use lagged variables leads to results that improperly assume that capital formation is instantaneous. The Phoenix model assumes, effectively, a UNE-P line added, for instance, December 1st, results in a large increase in investment expenditures by the Bell company losing that line by December 31st.

8. Further complicating this time element is that there is likely to be a distinct difference between the pace of investment growth during an expansion and the rate at which the capital stock is reduced during a contraction. While it is sometimes economic to expand rapidly, firms tend to depreciate capital slowly (or sell at distress prices). This set of considerations makes it important to use a model that allows for investment decisions to be made incrementally, over time. When a more realistic approach is inserted into the Phoenix models, one that allows for investment decisions to span more than one calendar year, the UNE-P/investment correlation disappears, as shown below.

C. Alternative Models

9. The Phoenix study results derive from spurious correlation – that is, an observed connection that does not result from a true cause-and-effect relationship. This is demonstrated by the fact that alternative models that produce different results are superior to the Phoenix models both in terms of their economic logic (that is, they are based on assumptions that are more realistic) and in their ability to fit the data (meaning that they explain a higher proportion of the variation in BOC investment). We present three such alternative models here. These models do not, by themselves, prove a negative relationship between UNE-P and ILEC investment. Instead, they demonstrate that the data do not support the results asserted by the Phoenix study.

10. The first alternative adjusts the Phoenix model in several respects. First, we add additional data from the second half of 1999 (when UNE-P growth began in some states); second, we measure the data semiannually instead of annually; third, we measure investment as capital expenditures (rather than net investment)[2]; and, fourth, we evaluate BOC investment[3] at the company level rather than at the state level.[4] If the Phoenix study had identified a true statistical relationship in the data, we would expect to see their results confirmed. However, this analysis shows a *negative* relationship between UNE-P and BOC investment, the opposite of what the Phoenix model produces. See Table A2.

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[2] By using gross investment (capital expenditures) instead of net investment we are able to include Qwest in our analysis, as these data exist throughout the period.

[3] We include Qwest among the BOCs.

[4] The estimated equation is:

$$I_t = C + R_t + UNEP_t + \varepsilon_t$$

where I_t is gross investment by a BOC; C is a constant; R_t is the BOC's revenues; $UNEP_t$ is the BOC's number of UNE-P lines; and, ε_t is the error term. We estimated the equation using Ordinary Least Squares.

Table A2
Gross Investment Estimated Across Companies

Dependent Variable: Gross Investment by BOC (semi-annual) Sample: 1999:H2 to 2002:H2 Number of *observations* = 28			
Variable	*Coefficient*	*Standard Error*	*P-value*
Constant	1,288,243,000	620,217,900	0.0482
Revenue	0.229932	0.033951	0.0000
UNE-P lines	-692	274	0.0184
Adjusted R-squared	0.628		

11. This alternative model shares many of the weaknesses of the Phoenix model, yet it explains BOC gross investment better according to standard economic metrics. This company-based regression explains 63% of the variation in investment compared with only 44% in the Phoenix Model 2 (and 28% in Phoenix Model 1). The constant, revenue and UNE-P coefficients show significance at the 95% level, whereas in the Phoenix Model 2 the estimated coefficients for the constant and revenue variables were insignificant.[5]

12. The second and third alternative models we use correct two other errors in the Phoenix models: the incorrect weighting of the state-level observations, and the incorrect assumption that wireline telephone companies adjust their entire capital stock instantaneously to the desired level each year. Phoenix Model 1 does not divide state-level variables by the size of the state, which has the effect of assigning disproportionate weight to large states, and effectively ignoring small states. Phoenix Model 2 adjusts two explanatory variables (revenues and UNE-P lines) for state size, but does not adjust two other explanatory terms (the constant and dummy variable). This inverts the state-size problem, giving undue influence to the little states. Either of these errors destroys the validity of the statistical results obtained.

13. To fix the first problem we weight each state-level observation in proportion to its share of total lines. Each state then exerts influence in proportion to the number of lines

[5] In econometric modeling, it is customary to test whether or not the estimated coefficient on a variable is distinguishable from zero (statistically, "significantly different from zero"). An explanatory model with estimated coefficients not significantly different from zero is suspect. Half the coefficients in Phoenix Model 2 (those on the constant term and revenues) are not statistically distinguishable from zero. All of the coefficients in the model reported above are significantly different from zero; the -$692 estimate of the effect of a UNE-P line on investment would, given the model's assumptions, be observed by chance alone only 1.84% of the time.

it represents, enabling valid statistical tests to be performed. We do this for both alternative models.[6]

14. A second correction applied to the Phoenix Center's analysis eliminates their assumption that BOCs instantly adjust their entire capital stock to exactly the level desired given that year's revenues and UNE-P lines.[7] This is unrealistic in times of expansion, but it is even more unrealistic when firms are reducing capital stock. Reductions are largely constrained by the rate of depreciation, as well as by regulatory obligations.

15. The economic literature offers guidelines for modeling this kind of investment adjustment. One approach is based on the idea that, while firms aim to achieve a desired level of plant and equipment each year, they appreciate that this is a moving target. They rationally believe that circumstances may change. So, to hedge their bets, firms do not attempt to move to a new level of capital stock in just one period, but invest more conservatively by reaching for their goal incrementally. This spreads the process of capital formation out over several years, yielding the flexibility to see what events transpire as they go. This approach is theoretically superior to the instantaneous adjustment model specified by Phoenix. Our second and third alternative models are each based on this dynamic adjustment scheme, in which the optimal level of infrastructure is built over time.

16. Our second alternative model corrects the Phoenix model to properly adjust for state size disparities and to allow for phased investment over multiple years.[8] The two explanatory variables, revenues and UNE-P lines, are also defined as their *actual* levels in a given year rather than their annual *change* (as they were in the Phoenix specifications).[9] The model is then estimated using the Phoenix dataset. See Table A3.

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[6] Since our first alternative model (above) was at the company level rather than at the state-level, it does not suffer from the size disparity of the Phoenix Center models.

[7] The Phoenix study's use of changes in revenues and UNE-P lines, as opposed to using the total amount of revenue or UNE-P lines, can only be economically justified if the capital stock adjusts to its new desired level within the year. This can be seen by realizing that if it took more than one year to adjust, then this year's investments would be determined, in part, by last year's changes in revenues and UNE-P lines But neither of the Phoenix models incorporates such information from previous years.

[8] The estimated equation is.

$$I_t = C + R_t + UNEP_t + DUM02_t + CS_{t-1} + \varepsilon_t$$

where I_t is net investment; C is the constant divided by the number of access lines in the observation; R_t is revenue; $UNEP_t$ is the number of UNE-P lines in the observation; $DUM02_t$ is a dummy variable equal to 1 if the observation is from 2002 and zero otherwise; CS_{t-1} is the previous period's net capital stock; and, ε_t is the error term. We estimated this equation by a "pooled" least squares estimation procedure that recognized that the dataset consists of observations on multiple company-states for two separate years (technically, a pooled time series of cross sections) and weighted each observation in proportion to that state's share of lines.

[9] This adjustment is made to introduce the time element, as represented by the lagged capital stock variable.

Table A3
Partial Adjustment Model

Dependent Variable: Change in net capital stock per BOC line Sample: 2001, 2002 Number of observations = 52			
Variable	*Coefficient*	*Standard Error*	*P-value*
Constant	59,004,265	10,949,767	0.0000
Revenue	0.081032	0.027413	0.0049
UNE-P lines	70.76159	92.74734	0.4493
2002 Dummy	-97,734,335	9,493,324	0.0000
Lagged Capital	-0.102724	0.018927	0.0000
Adjusted R-squared	0.982223		

17. Our results show that the effect of lagged net capital stock – that is, our adjustment to account for the fact that firms adjust capital stock incrementally -- in predicting BOC investment is statistically significant. The impact of UNE-P lines, however, is not. These results demonstrate that simply adjusting for differences in state sizes and allowing capital stock changes to be phased-in rather than instantaneously achieved eliminates the statistical inference asserted by Phoenix. By using slightly more realistic assumptions, in other words, the correlation between UNE-P and BOC investment is lost.

18. The third alternative model also weights the state-level data by size and allows capital stock changes to be phased-in rather than instantaneously achieved. In addition, it replaces the 2002 dummy variable (constant over all states) in the Phoenix Center models with a variable proposed on page 11 of the Phoenix study. According to the Phoenix study, the dummy was intended to capture: "...time-variant factors that are constant across states such as the cost of capital." Yet, the cost of capital is not constant across states, and the weighted average cost of capital (WACC) varies by company. Using a model that weights each state in proportion to lines, permits capital stock adjustments to take more than one year, and includes each BOC's cost of capital, results in an equation[10] yielding the estimated coefficients in Table A4.

[10] The estimated equation is:

$I_t = C + R_t + UNEP_t + WACC_t + CS_{t-1} + \varepsilon_t$

where I_t is net investment; C is the constant divided by the number of access lines in the observation; R_t is revenue, $UNEP_t$ is the number of UNE-P lines in the observation; $WACC_t$ is the weighted average cost of capital for the BOC; CS_{t-1} is the previous period's net capital stock; and, ε_t is the error term. We estimated this equation by pooled least squares.

Table A4
Weighted Average Cost of Capital Model

Dependent Variable: Change in capital stock per BOC line Sample: 2001, 2002 Number of observations: 52			
Variable	*Coefficient*	*Standard Error*	*P-value*
Constant	1,080,000,000	146,000,000	0.0000
Revenue	0.110774	0.028155	0.0003
UNE-P lines	-107.0911	101.7795	0.2981
WACC	107,000,000	13,969,627	0.0000
Lagged capital	-0.093514	0.024526	0.0004
Adjusted R-squared	0.150937		

19. These results show that the effect of an additional UNE-P line on investment is negative, but statistically insignificant. The cost of capital is shown to have a positive and significant coefficient.[11] Again, the Phoenix study results do not stand up when alternative models, or data, are used to test the economic relationships asserted. Our conclusion is that the Phoenix study reveals no evidence of the true causality between UNE-P and telecommunications investment.

[11] This contrasts with the negative coefficient on the dummy variable it replaces.

I declare, under penalty of perjury, that the foregoing is true and correct.

Thomas W. Haslett

Executed on: September 2, 2003

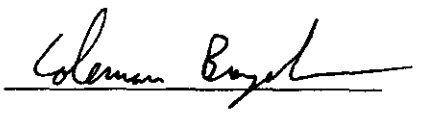
I declare, under penalty of perjury, that the foregoing is true and correct.

Arthur M. Havenner

Arthur M. Havenner

Executed on: September 2, 2003

I declare, under penalty of perjury, that the foregoing is true and correct.



Coleman Bazelon

Executed on: September 2, 2003